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THE AGRICULTURAL STUDENT

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PUPILS LEARNING NAMES OF PLANTS AND SPLICING ROPE.

THE AGRICULTURAL STUDENT.

VOL. XI. OHIO STATE UNIVERSITY, COLUMBUS, DECEMBER, 1904 No. 3

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EDITORIAL CHAT.

Once again the International Fat Stock Show has come and gone, and once again in the placing of awards, the colleges of agriculture have demonstrated that they are not to be overlooked, when it comes to a consideration of the results of animal husbandry. Only a few years ago, there were many men, even among livestock breeders, who looked upon the teaching of animal husbandry in colleges as impractical, but during the last few years it has been shown by the manner and success with which these colleges have entered the show ring that it is practical, and will continue to be so. Again an agricultural college carried away the honors of showing the championship steer, with other colleges well up in the race. The inability of Ohio State University to enter this contest is to be regretted, but we are living in hopes, although we can do no more at present than extend our congratulations to our sister institutions for the showing that they make. Ohio should be up with the other states in this respect, for in animal production she falls behind but few states in the Union, and this should be an incentive to the farmers and others to place the institution in the position in which it rightly belongs.

Education in Horticulture.

It is claimed by those able to judge that there is a large proportion of useless work expended in our common and public schools. It is unhesitatingly asserted that some of the branches there taught are nearly or quite useless in themselves, and that other subjects are so burdened with petty details that the real purpose or object of the study is obscured. In other words, the pupil loses much of the time spent on some subjects and gains little or nothing of what other subjects might and should have brought him.

It is generally conceded that there are three factors in any well-rounded education. These are *knowledge, training* and *culture.* This means the education of all the faculties, the development of the physical, mental and moral forces, so that man shall be fitted for his most perfect work! It goes without saying that the nearer we can come to a symmetrical and perfect development of the mind, soul and body, the better are we prepared for the work of life.

The true teacher must ask, and as far as possible answer the following questions for each of those committed to his care:

First—What knowledge do you most need?

Second—What training do you most need?

Third—What culture do you most need?

In other words, *to know something, to do something,* and *to be something,* comprises a large part of the best preparation for true living. Such an education enables its possessor to perform his duty in all the exigencies of life, and brings him the most complete and lasting happiness of which he is capable.

As a rule the means for acquiring knowledge and culture have been well provided for in our various systems of education. Studies and means of instruction are usually selected with reference to their supposed ability to answer the following demands, viz.: First, what is value of the learning they will give, and second, what is the value of the culture their mastery will bring?

Whether the means employed always give the best knowledge, or bring the truest culture may be questioned.

There can be no question, however, about the lack of training. Of teaching there may be a plenty; of training of the right kind there is a dearth. It may be difficult to state the exact difference between teaching and training. In a broad sense the teacher includes the trainer. In a common and narrower use of these words the difference may be stated as follows:

Teaching means imparting knowledge: conveying ideas: it shows what has been done and why it has been done; it explains causes and deals with theories and principles; it stimulates and inspires the pupil or student to mental activity. Training does little in the way of imparting knowledge; it shows methods; it deals with the *how* rather than the *why;* it applies rules and principles to the practical affairs of life; it stimulates and inspires the pupil or student to some form of physical as well as mental activity.

The teacher demands that the pupil or student shall study; the trainer demands he shall work, or at least blend labor with study. We live in an age that demands a system of education which recognizes the truth that man is by nature a worker, a moulder and ruler of matter,—an age which is beginning to realize that daily physical as well as intellectual effort is one of the conditions of a healthful and happy existence. In short, what the age demands

is the education of the head, heart, and hand together, each to be the ally and complement of the others.

It needs no argument to show that the education or training required to make an able lawyer, or an efficient clergyman is not the same as that which is essential to the proper equipment of a farmer or an engineer. The routine of the classical course may do for the former, but it will fail to properly develop and equip the latter.

The Spanish-American war demonstrated that the training, manual as well as mental, that is given by our national military and naval schools is just what is best calculated to fit a youth for eminence and renown as a military or naval commander. If this be true for the art of war, can it be any the less true for the peaceful arts and great industires of our time?

Shall rigid, persistent manual training with implements of destruction count for so much and the choice and use of implements of production count for so little? No! We should train men for peace as well as for war! We should give our aspiring youth an opportunity to do better than their fathers in every field of blended intellectual and industrial effort, and show them in what direction further improvement is to be made. Among the more prominent arts and industries perhaps there is none that has superior advantages over horticulture. This art consists primarily in transforming, by means of cultivation, the crude and unused elements of earth and air into valuable food products or living objects that minister to our æsthetic nature.

It is both an industrial and a fine art, readily separating itself into four great divisions, each of which may be many times subdivided.

These four divisions are:

I. Pomology or fruit culture.
II. Olericulture or vegetable gardening, including seed growing.
III. Floriculture—commercial and amateur.
IV. Landscape-horticulture, or the chief factor in landscape gardening.

No vocation is more conducive to physical and moral health than that of horticulture. But horticulture is more than a healthful vocation. Its intelligent and successful practice is based upon great principles which have been deduced from the natural and physical sciences. The horticulturist stands face to face with problems which require for their solution the amplest knowledge of nature's laws, the fullest command of science and the best efforts of the human intellect. In other words, horticulture is an intellectual purusit and in its practice the strongest minds may find scope for profitable employment Every useful vocation is respected in proportion to the measure of intellect and skill it requires and rewards.

Horticulture is esteemed by all and the reason is obvious.

It is in the realm of fine art where horticulture has the deepest and most abiding influence. There is a wealth of beauty in tree and shrub; in fruit and flower and leaf,—a beauty which according to Emerson's averment "is its own excuse for being."

When horticulture as a fine art arranges trees and shrubs, flowers and lawn, so as to present an expressive picture to the eye, the beauty is multiplied, and this development of the beautiful is the aim and object of all landscape-horticulture.

Perhaps enough has been said to prove the advantages of horticulture as a means of training. Its advantages as

a vocation or life work could be shown quite as easily. In doing this the object is not to belittle or disparage any other legitimate method of training, or any other calling. Other vocations are useful even necessary, and many follow them with advantage to themselves and to others.

The fact remains, however, that horticulture is the first and most essential of human pursuits, and the interests of all demand that it should be honored and prosperous. To pursue this vocation with satisfaction and profit boys and girls must be trained therein. To this end manual training departments in horticulture should be established and maintained in connection with our elementary and high schools. The small amount of land required and the necessary equipment in the way of tools, seeds, etc., would not be expensive. For winter and to use during the inclement weather of other seasons, a glass structure in the external form of a small commercial greenhouse should be provided. The work undertaken in these training departments should embrace among other things, the laying out of a model kitchen garden, a market garden, and small fruit plantations. It should include also, the cultivation of flowers, shrubs, and trees. In connection with the above the various operations of propagating plants by seeds, cuttings, layers, budding, grafting, as well as pruning, transplanting, etc., should be thoroughly taught. The collection and planting of weeds, the breeding of the more common injurious insects; the use of insecticides and fungicides, the observation and study of our useful birds; the management of bees, and other similar subjects might form a part of the instruction and training. In short it would be a training *by* horticulture, as well as a training *in* horticulture, and should prepare for a training *for* horticulture.

In addition to the tools of the shop, we urge the tools of the garden. The hammer and the saw should be supplemented by the hoe and the rake. The budding knife and the pruning shears, as well as the plane and chisel, should be used to educate the hand and eye.

We hear much in this day about reform in our systems of education. In an age of free-school, and compulsory school attendance, there should be more and better fruit gathered from the tree of knowledge. That is certainly a defective, if not radically false system of education, which leaves its subject no better qualified for any useful calling, with no more strength to wrestle with adversity, with no more power to maintain a healthful independence than though he were unlettered or untrained.

The great problem of educational reform is the proper blending of labor with study, so as to develop skill of body as well as vigorous activity of mind.

We need a system of education which recognizes the fact that men and women were placed on this earth that they may work, and that every attempt to escape this destiny should subject the offender to the logical penalty. A pupil so trained in our common and public schools should be able to nearly or quite work his way as a student through college or university, and would then go forth fully equipped to meet the responsibilities of life. WM. R. LAZENBY.

The first Twilight Concert of this college year was held at the University Chapel at 4 o'clock, November 4. Quite a crowd of students and faculty attended. The concert was given by W. H. Crane. The next concert will be held in early December.

Naming and Testing.

There are so many common minerals and species of plants and animals that no one short of a trained geologist, botanist, or zoologist would be expected to follow out through carefully-prepared tables the characteristics or markings of the family, order, genus and species to determine the name of the mineral, plant, or animal.

Such a knowledge of the sciences may be desirable by the farmer of today. Since he hasn't it we must proceed in the elementary school work to help him indirectly through his children and prepare them, the future farmers, to become better acquainted with their environment.

them. From learning to know the name they learn to observe; incidentally the gross characteristics are learned and at a seasonable time they are talked over. This work in our schools has become a part of the Friday afternoon exercises. The regular reading and geography classes furnish opportunities for incidental work.

The most common names of parts of plants and animals are learned by using them when necessary; pollen is called by that name not "flower dust"; the corolla and calyx are referred to by those names, not by their compounded definitions. In the study of physiology quite enough terms are learned that may be used in the study of animals and insect

AN EXHIBIT BY SUPT. GRAHAM'S BOYS AND GIRLS.

The college student is expected to determine from a key to invertebrates what genus and species the insect before him belongs; in like manner he and the high school pupil determines from a key to what order, genus and species the plant in hand belongs. For the boys and girls of the elementary school there is no such tedious and painstaking work; they must be told the name by the teacher. It has been observed that children learning the names of insect, plant, or mineral are on the lookout for

life. The elementary school is no place for an orderly arrangement of definitions and a careful and painstaking wording of them. After a few years of what has appeared to be a miscellany of nature work, the pupil has quite a catalogue of names of things once looked at but now seen; he has a keen eye for color, form and size and an ear that keenly discriminates one sound from another; to a greater or less degree he begins to give some order to the many facts acquired. This year more pupils

have entered the high school to further their work in science as well as in literature and mathematics. Those who could not enter high school have gone back to the farm with such a knowledge of elementary science that they can read and properly interpret more of agricultural literature than half the farmers.

Children should learn to know the common teasel from the Canada thistle; many farmers do not know one from the other; Indian mallow is in many places known as butter-mould from the fancied resemblance of the seed pod to a buttermould. It is seldom referred to in print by the latter name. Horse weed is often considered as a large rag weed, etc., and I am mindful of the fact that many plants are known by more than one name. If our children are to read bulletins on the destroying of weeds, and are to sit and listen to lectures at farmers' institutes refer to them, they should be taught to know them by the most common name.

Many children cannot distinguish a bluebird from a bluejay; some are not sure they know a robin; and the brown thrush is, to most children in elementary schools, an entire stranger. Too many children divide birds into two classes: English sparrows and other birds. If they are to know this second class either for their beauty of color or song, or for their economic value, the first step is to learn to know the bird by name when seen or heard. It has been found that to know the name of plant, bird, or insect has led most pupils to find out its habits and characteristics.

The Ohio Weed Manual (Ohio Experiment Station, Wooster, O.); A First Book of Birds; Mrs. Wilson's Nature Study Manual; Burkett, Hill & Stevens' Agriculture for Beginners; Goff & Mayne's First Principles of Agriculture; Shy Neighbors; Bass's Stories of Plant Life; Stories of Plant Life, and Hopkins Rocks and Minerals have helped both teacher and pupil in securing names and descriptions.

Time after time our pupils have looked over the school ground to find as many different kinds of life-plant and animal and minerals as they could. Many times they have gone far beyond the schoolyard and have found the fields, fence rows, and woods teeming with material for investigation. Eyes begin to open and minds begin to awaken.

Soon the statements of the poems are put to the test:

"The wind flower and the violet,
They perished long ago.
The brier rose died amid the summer's glow,
But on the hill the golden rod
And the aster in the wood," etc.

Did Bryant name the plants in their seasonal order?

"In days that are sunny,
He's making his honey;
In days that are cloudy,
He's making his wax."

Does the bee make honey on sunny days and reserve himself for cloudy days to make his wax?

"On pinks and on lilies
And gay daffodillies
And columbine blossoms
He levies a tax."

Do you really think he levies much of a tax on the flowers named ?

"Underneath the pine's tall spire,
Cardinal blossoms burn like fire."

What do we find as to the habitat of the cardinal flower and that of the pine that are common?

From all this work we have found a fuller appreciation of nature in literature and at the same time its economic value was not lost sight of.

"Flower in the crannied wall,
I pluck you out of the crannies," etc.

Nature, the old nurse, took the child upon her knee, saying: "Here is a storybook thy father has written for thee," etc., now have a meaning that no end of explaining at the time of reading only would give.

The testing of rocks with acid to learn whether they were limy, (calcarerous) or not has been a very interesting work. How nature has furnished the ingredients and mixed them, making a soil rich in plant food furnishes interesting work. Testing the soil with litmus paper to determine whether it is acid (sour) or not has proven worth a great deal since a few times it has determined pretty definitely why clover would not grow in certain places. The naturalizing agent, lime, was immediately suggested.

All of this work is inviting further interest from the farmers who desire much of it, as they should, for its value in the farm economy. They are gradually learning to know more of insect pests and of the value of our native birds. While these results are indirect, the direct cause result will be a farmer or farmer's wife whose knowledge will lead not alone to a life of dollars and cents, but to a broader, fuller, and more perfect life in full harmony with the beauty and grandeur of his surroundings and with a greater reverence for the Creator who has made him a small factor in working out His great plan.

A. B. GRAHAM.

The Use of Aquariæ to Illustrate Interdependence of Animals and Plant Life in Communities.

One of the interesting problems that confronts the biologist is—why are animals and plants as we find them in nature able to live continuously in a given region of territory without becoming extinct, since as a rule the only source of food supply is the forms found on the given territory or in the given colony. It is an exceedingly complex problem as studied in our forests, ponds or streams, but is possible by the use of aquariæ to isolate a small portion of the plants and animals with which to experiment and put them under such conditions that we can tell why the colony succeeds or does not succeed. A simple method of trying this experiment is to take a small quantity of water plants, willow roots and dead leaves, such as we find in our college lake in abundance and place them in a tall round jar in a window. If the experiment is to be a success they should not be placed in a flat jar on account of the difficulty of observing what goes on, and they should not be placed in a dark part of the room because all of these forms need light. The advantage of a large round jar in addition to the ease of observation, is that the forms are magnified somewhat. In a jar prepared in this way we would be likely to have five of the lowest orders of plants represented, and all of the invertebrate groups except the one to which the star-fish belongs. This makes five great groups of plants and six great groups of animals, which, if the aquarium is properly regulated, may live together for months without the loss of any one of the groups.

There are three practical difficulties in regulating an aquarium. In the first place there may be so many plants that the jar will become practically filled with them, thus crowding out the animals. Second: There may be so many animals that their food supply will run short and the aquarium come to grief for this reason. Third: There may be so much material that is on the point of decaying that the bacteria ruin the aquarium. Now if the ratio between plants and animals can be properly ad-

justed, the proper amount of sunlight secured, and a sufficient surface to enable the animal forms to carry on respiration, the aquarium may go on almost indefinitely, just as the plant and animal communities do in nature.

In order to understand the problems which the aquarium presents, it will be necessary to make a brief list of the forms which are likely to be found in material collected in the manner described. Of the plants we are sure to get a great many bacteria, several species of diatoms, and a number of desmids, and a great deal of algæ. These are all one-celled plants except the algæ, which consists of strings or rows of cells and comprise most of the green matter found in ponds and streams. Of the animals, there would be a great number of protozoa or one-celled animals of which the amœba is a good illustration. Just above the protozoa comes a group of animals to which the coral-forming types belong. This group will be represented in our aquarium by hydra, a beautiful little form which occurs in great abundance. Its body is hollow like a tube, one end of which is attached, the other bearing a number of long waving tentacles which it uses to secure and convey food to its mouth. Of all the forms found in the aquarium, this will furnish the student the greatest amount of interest. It is easily fed, its reproduction by budding can be observed and the transparency of the body renders the securing and disposing of food easy to observe.

Just above the group to which the hydra belongs comes the group of worms, which may be represented by a number of different forms, but there is one in particular, a turbellarian, which is a beautiful and very interesting form and which plays an important part in an aquarium. These forms are brownish in color and flat and leaf-like in shape and can be detected by their slow gliding movements on the surface of the jar.

Above the group of worms comes the group of mollusks, which will be represented in our aquarium by one or more species of water snails. Above the mollusks comes the group of crustaceans to which the cray-fish belongs, which will be represented in our aquarium by a number of species, but in all probability by a little form called cyclops. These smaller relatives of the cray-fish can be detected by their darting movements in the water. They rarely swim steadily.

Following the group of crustaceans comes the group of insects, which may be represented by a great variety of forms in our aquarium, especially larval forms. There is one form, however, which is almost certain to be picked up in any mass of material and that is the larva of the dragon-fly. These are such active feeders that they form a very important part of the aquarium community.

As to the relations which exist among these different forms, if the ideal conditions to be desired can be secured, that is, the proper number of plants and the proper number of animals, the proper amount of light and the proper degree of temperature, the activities carried on in our aquarium will duplicate those occurring in any pond or stream such as those carried on in our college lake.

In nature these conditions have been maintained for a long time, so that plants and animals have adjusted themselves to them. Our aquarium is likely to be successful just so far as it duplicates natural conditions with possibly one exception.

There is one particular in which our experiment bears an unknown relation to otherwise smaller conditions in nature, and that is in the amount and use of oxygen and carbon-dioxide. Animals, in respiration, take in oxygen and give off carbon-dioxide. Plants, in respiration, do the same thing, but in the manufacture of starch take in carbon-dioxide and give off oxygen. This process of elaborating starch is done by the chloropyl or green coloring matter of plants when acted upon by sunlight. So that if an aquarium is kept in sunlight it has within the jar the means of furnishing both oxygen and carbon-dioxide, the plants and animals being mutually helpful. The aquarium is, in a measure, self-supporting as far as these two gasses are concerned. Practically, however, it is well to allow enough surface for the absorption of oxygen at night and on cloudy days and during prolonged absence of sunlight. There can be little doubt but that both plants and animals profit by the presence of each other in the aquarium.

In a general way our aquarium problem is simply a problem of food supply or can be resolved into that. All of these forms, both plants and animals, reproduce so rapidly that if furnished a proper food supply and relieved of the attacks of their enemies they would occupy all the available space in the aquarium. They do not do this because their numbers are reduced constantly by the other forms that feed upon them.

In a general way it may be stated that the animals highest in our scale feed upon lower forms and that these in their turn feed upon the plants. If the condition is favorable for plant reproduction the aquarium will not fail on account of food supply. It may, however, fail on account of unfavorable conditions of light or temperature.

The food problem in our aquarium is somewhat as follows: The protozoa feed upon the one-celled plants largely and to some extent upon the one-celled animals. The hydra, the next highest animal in the series, feeds to some extent upon one-celled plants and animals, but it is such a voracious feeder that it secures many of the relatives of the crustaceans like the cyclops. The next number of our series, such as the turbellarian, seems to feed largely upon the one-celled plants. The snail, which is an exceedingly active feeder, devours mainly the plants, but seems to secure, owing to its peculiar method of feeding, that is, scraping the sides of the jar with a rasp-like tongue, many of the unicellular animals as well. The smaller relatives of the cray-fish seem to devour both small one-celled plants and one-celled animals indifferently. The dragon-fly larva feeds in the same voracious manner.

In this problem of food supply there seems to be just one rule observed by all of these forms, that is, that any form may eat any other form smaller than itself. This rule does not apply to hydra, which, owing to the shape of its body, devours forms which are much larger than itself. In considering a successful aquarium, two members of this series may be reduced in numbers at once. As a rule there should not be more than one dragon-fly larva and not more than one or two snails. Of the whole series these are the largest and most active feeders and they are most likely to disturb the equilibrium of the aquarium.

It is apparent at once that the foundation of this whole food supply is the one-celled plants. A pond containing plants such as diatoms, desmids and algæ is almost sure to afford an abundance of animal forms. The role of the bacteria seems to be largely that of dis-

posing of the lifeless forms of either plants or animals.

To the observer, the activities in the aquarium seem to be largely those of catching something to eat or escaping being eaten by some other animal. The intensity of these activities almost bewilder one. The smaller crustacean like cyclops may escape the ravenous mouth of the dragon-fly larva, only to swim into the devil-fish-like tentacles of the hydra. Whole colonies of one-celled plants and animals may be wiped out of existence by the rasp-like tongue of the snail or the proboscis of the turbellarian. During all this attempt to secure food the process of reproduction goes on rapidly in order to keep each species at almost its normal number.

In conclusion, in order to show that our aquarium problem is not an isolated problem, but is really typical of almost any animal or plant community, it may be well to call attention to the relation which the higher members of our aquarium series bear to the lower members of higher groups of animals. For instance, smaller crustaceans, snails and insect larvæ represent almost the total food supply. Small fish furnish much of the food supply of large fish, while these in their turn furnish the food supply for many predacious birds, reptiles and mammals, and in some portions of the globe almost the sole food supply of man.

This intricate chain of relationship from the one-celled plants to man is maintained constantly in nature. It has been worked out through long ages of unconscious experiment until it is maintained in a nicety of balance that is almost incomprehensible.

Registration figures at Cornell show 178 in the agricultural college.

Bacteria in Relation to Agriculture.

There exists, in nature, two forces, a visible and invisible one. To the latter belongs those forces which are of greatest value. Under this head is classed those micro-organisms which recently have been called bacteria. Although they had been known to exist for a long time it remained for Pasteur and others to make a thorough study of them. The varieties are almost as numerous as the sands of the sea. In these forms of life specialization is found in a very high degree. A large number have something to do with agriculture directly. To discuss all of these forms would require more time and space than can be devoted to this paper. Therefore, it shall be necessary to limit this discussion to those species which have to do with the soil and its fertility.

The rocks through the processes of disintegration and decomposition are gradually changed into soil varying in texture from clays to sands. The forces that are acting to produce this complete change of rock into soil are, in so far as we know, the solvent power of the secretions of the plant, the vital activity of the rootlets, the decomposing influence of soil ferments or bacteria, etc. The relative importance of these forces are not definitely known. But that the action of the acids contained in the secretion of the roots is not capable of exerting a very great influence is very evident. It is quite probable that the preparation of the soil particles for plants is due quite largely to bacterial action. This fact, however, has never been fully recognized. There is no doubt whatever of their decomposing action in the liberation of plant food locked up in the undecomposed mineral structures. When we stop to think that these organisms are found

through every particle of soil we can easily see of how great importance they are in this capacity alone.

Early in the process of rock disintegration we find the nitrifying bacteria present. They are not only found on the surface of the rock but are also found beneath the surface. It may seem strange to find them here, but they have been found to thrive in an entirely mineral medium. Here they pave the way for the growth of lichens and the more rapid decomposition of the rock. For them to do this it must be remembered that they are capable of taking from the air ammonia and carbon-dioxide. They in their action cover the fragments of rock in the early stages of decomposition with a layer of organic matter. There is thus formed quite early in the formation of soil the characteristics of a vegetable soil. This proportion increases constantly, due to these bacterial processes and later to the growth of lichens, until the soil is capable of producing and sustaining plants.

Another form of bacteria or ferment is those which act upon the nitrogenous matter in and on the soil, oxidizing them to nitric acid. These are the nitrifying bacteria and are of great importance to the farmer. With these as with all others there is an exceptionally large number of species. First let us look at those forms that have to do with the first step in the process of nitrification. These act on the organic matter, breaking down its structure, and in this way furnishes the material with which the next form works. These are universally of great importance. They are found constantly in the soil, the air and rainwater, and it is through their action that all refuse matter is disposed of. They work best when the temperature is about 70-80° Fahr. These bacteria in their life processes give up ammonia. Just how the nitrogenous material stored in humus is reduced is not exactly known. This is due partly to the fact that this form is not as thoroughly understood as the other forms in the nitrifying process.

The next form are those which use the ammonia in their life processes, oxidizing it to nitrous acid. At this point there is danger of the ammonia being lost since these bacteria cannot thrive in a medium containing an excess of this substance. This species is the largest and most vigorous of the nitrifying forms. They multiply by spores which develop rapidly.

The next and last form are those which take up this ammonia given off by the other forms and in their life processes oxidize it to nitric acid. This step is necessary in order that the highly valuable plant food be made available, since the plants as a rule can only appropriate nitric acid. The action of these forms are continuous during the warm weather, and it is these that keep the nitrogen supply at a certain place.

Besides these there is another form which deserve our attention. These are the forms that fix the free nitrogen of the air, more especially those that have established symbiotic relations with the legumes. Of these there are many species, in fact almost a distinct species for each species of the legumes. As we look into the future we can easily see that this genera will be the most important of the nitrogen forms. At the present rate the supply of the nitrogen in the soil will soon be exhausted, and if it were not for the fact that nitrogen can be oxidized a nitrogen famine would be facing us. This species have acquired the habit of taking the free nitrogen from the air and in their life process oxidizing it and giving it to

the plant in an available form. In its life processes more of the nitrates are formed than is taken up by the plant, and thus the soil is enriched by their action. Just how this is done is at present not definitely known.

We have just seen how bacteria aid in the enriching of the soil. If these processes could be kept up to the maximum the nitrogen problem would not be a very serious one. The facts are, however, that many times the conditions are such as to favor another form of bacteria whose life processes are those of deoxidation. These forms are known as the denitrifying bacteria and their life process as denitrification. These seize upon the nitrates and nitric acids deoxidizing them to free nitrogen. These, however, are not abundant and cannot thrive well unless the conditions are detrimental to the nitrifying forms.

All over the world there is an attempt being made to supply the nitrogen deficiency of the soil by the application of fertilizers containing nitrates. One of the most valuable sources of this nitrate are the large beds in Chili. These beds of nitrates are due to the decomposition of marine vegetation. At places vast areas of the ocean bottom were covered with a dense vegetation. This became charged with organic matter highly nitrogenous. A change in elevation occurred; this area was raised above the sea level, possibly forming a lake. As evaporation went on the organic matter collected on the bottom of the lake. Finally oxidation and nitrification due to bacterial action occurred and the organic nitrogen was changed into inorganic nitrates. Thus we see that the action of bacteria in these deposits have given to the world the large beds of nitrates such as those found in Chili, which prove of utmost importance in increasing the yield of crops.

Recent deposits of nitrates are found in caves and in isolated places. The origin of these beds is somewhat different from the above. The material which formed the basis of the cave deposits consisted of the dejecta and bodies of the large number of bats that formerly congregated there. This material was worked over by the bacteria, giving to the world the valuable nitrates. Those deposits in the isolated places were formed by the action of bacteria upon the great amount of excrement and bodies of the exceptionally large number of birds that once frequented these places. These ferments produced nitric acid which if the conditions were favorable combined with a suitable base, giving us the large deposits of nitrates. Besides this the debris of insects, fragments of elytra, scales of the wings of butterflies, and other animals which are brought together in great quantities form the basis of other beds.

Thus we have seen that bacteria are the source of the most valuable of plant food. It is upon these micro-organisms that the future supply of nitrogen for plants will depend. Since farming is intimately connected with plant growth the success of farming operations is therefore largely dependent upon bacterial action. The relationship of many other forms of bacteria to agriculture could easily be shown, but these are sufficient to show the intimate relationship of bacteria to agriculture.

High Grades and Cross-Breds vs. Pure-breds for the Block.

While many of the breeders of improved livestock at the present time have engaged in the business more as an avocation or on account of a desire to build for themselves a monument, durable and worthy of their best efforts, the prime object of the feeder, though

he may not be lacking in his appreciation of blooded stock, is money; and to accomplish this end in the shortest time possible with the least outlay of food and labor is his highest ambition. And the question of what breed of livestock he shall raise is one capable of much discussion and in the end not easily settled. To say that he should breed scrubs as moneymakers would be to cast reflection upon the occupation and would be contrary to past experience, though we are sorry to admit that many, conceited in their own ignorance, still persist in this very practice. High grade, crossbred or purebred stock, then, is the kind to which he must give his attention.

Purebred stock is not entirely to be desired by the feeder. Not only would the expense of maintaining a purebred herd be too great for the income derived from the sale of the offspring for the block, but evidence seems to favor high grades or crossbreds. We would not for a single moment depreciate the value of the purebred. Its mission in the livestock world has been a great one and the founders of all the improved breeds will ever live in the minds of agriculturists as benefactors in the highest and truest sense. But so long have some of these breeds been bred pure, and consequently more or less of inbreeding has taken place, that they have developed a fineness of bone, a delicacy of constitution which in many cases unfits them to some extent for the best block animals. This is well illustrated in the Poland China breed of hogs which now possesses too fine a bone and constitution to make the best hog for pork. To such an extent is this true of nearly all purebreds that a cross seems advisable in the production of block animals. By crossing we do not mean the injudicious and haphazard practice followed by many American breeders in recent years when cross after cross was made, and instead of having a crossbred vigorous and healthy, they had a mongrel, but rather a systematic and judicious use of crossing which seldom fails to introduce a vigor of constitution, a strength of bone and muscle, a quality of maturity which neither breed possessed before.

In regard to the Poland Chinas mentioned above, it is found that an outcross with some breed more rugged and prolific is very profitable. Professor Shaw, when experimenting on the subject at Minnesota Experiment Station a few years ago, said: "The cross of the large improved Yorkshire or Tamworth boars on Poland China sows gave offspring at once vigorous, growthy and relatively of more importance than pigs from the same sows bred to Poland China boars."

English breeders have long been fond of the Angus-Shorthorn cross, getting thus a hardiness, an ability to lay on fat not possessed by either of the breeds. The Hereford and Shorthorn cross on the little Kerry cow of Ireland has been productive of much good, getting thus size and strength in the offspring, the Kerrys being excellent sucklers while at the same time they live well on thin soil.

The Cheviot is found to "nick" well with Merino ewes on our western ranges, giving large, quick-growing, rustling lambs with more wool.

It is interesting to notice the results of fat-stock shows throughout the country. How often do we see crossbreds and grades competing for honors. Why do feeders choose them? Because their mingled blood elements give them a stamina and quality of maturity which, with judicious feeding, can accomplish wonders. The remarkable record of

the crossbred steer Challenger at the last International is worthy of note. Records of shows in England prove grades and crossbreds the equals and, in many cases, the superiors of purebreds which, coupled with the relative cost of producing, make them highly desirable. Nor are they lacking in the quality of meat produced, for the block tests show them to be singularly free from patchiness and other undesirable features.

True, there is danger in the practice of crossbreeding, for there is often a great temptation to retain the females of the first or second cross as breeders, when the power to transmit the destructive features of the breeds used is lost, and instead of improvement, reversion of a nature not to be desired is almost sure to follow. But with wise management and a due regard for the future, such a result can be easily averted. Under such a system it lies within the power of every feeder to produce stock which, though it may not equal the pampered pets of high feeding, can at least top the market with a fair return of profit. H. C. R.

Wheat and Its By-products.

BY LELAND E. CALL.

Of the cereals grown on the American farm, wheat must be placed first. It exceeds all others both in acreage sown and in amount harvested. In Ohio alone over 3,000,000 acres are annually sown, with an average production of over 39,000,000 bushels. Thus in taking up the consideration of wheat and its by-products we are considering a subject of utmost importance both to the Ohio grain producer and to the stock feeder.

It has only been within the last fifteen years that sufficient wheat has been produced to more than supply the demand for the consumption of man, and not until then did the price of wheat fall to within reach of the stock feeder. But when the price of this cereal closely approached that of corn it began to be fed in large quantities, and during 1893, 4,000,000 bushels of wheat was fed to stock in the State of Kansas alone; in 1894, the amount thus used in the state exceeded 8,000,000 bushels. Since the cost of producing wheat exceeds the cost of producing corn it will never become a common cattle food, nor could it profitably be fed at the present price of wheat, but should the market value fall the feeder should know its feeding value and be in readiness to make use of it.

Wheat compared with corn carries a higher percentage of starch, less ether extract and more protein, and thus more nearly furnishes a balanced ration for farm animals. It also more nearly meets the requirements of young growing animals and because a mixed food is more palatable than one kind of food fed alone wheat should be highly valued in furnishing variety.

Wheat is regarded as a satisfactory food for all farm animals; during mastication there is a tendency for the flower of wheat to adhere to the cheeks and gums in the form of a pasty mass, making it somewhat unpalatable; this, however, can be prevented by mixing with the wheat, bran, cornmeal or some other like substance. Wheat mixed with corn, oats or bran is considered a better food for horses than any of the others fed alone, and is of marked value for feeding fattening or milch cattle.

Wheat for fattening purposes is not considered equal to corn, yielding about 10% less returns. Swift & Co., in speaking of the character of meat of corn and wheat-fed cattle and hogs, says: "There is quite a perceptible

difference between wheat and corn-fed hogs and cattle. We do not consider that wheat-fed stock yields as well as corn fed, there being less fat. The lean meat on wheat-fed cattle has a brighter red than corn-fed cattle. The lean meat from wheat-fed hogs is very nice, but as the yield is not so good there is no particular advantage in it to packers, but we consider wheat-fed stock worth as much as corn fed." An objection made to corn-fed cattle, where yellow corn is used, is that the fat has a tendency to be yellow. This can be remedied by feeding part wheat.

Damaged wheat or shrunken grain which cannot and should not be sold can be used profitably by the farmer if fed to his stock in small quantities together with other feed.

Upon the examination of the wheat grain we find on the outside three membraneous coats which have much the same character as straw with about the same chemical analysis; beneath comes a fourth coat rich in protein and which during the process of milling goes with the other three to form bran. The embryo of the grain is rich in oil, protein and mineral matter, and the remaining portion consists of thin-walled starch containing cells. Associated with the starch is a protein matter called gluten which causes bread to be light and porous. In milling it is the purpose of the miller to secure all the starch and as much of the gluten as possible, but to separate out the germ and the four outside layers as they tend to make the bread dark in color; this is accomplished by first breaking the wheat grain into a few pieces and these are gradually reduced to flour by repeated bolting and grinding. Shorts consist of reground brand. Middlings contain finer bran particles and more flour and often the germ of wheat. In the grinding of flour 25 to 33% of the wheat is offal, available for stock feeding, and since the average consumption of flour in this country is 270 pounds for each person the by-product of the grain amounts to seventy pounds.

It has been reported that bread has been fed to horses in London with economy and success as a substitute for hay. Low grade flour can hardly be fed with profit when lower grades of by-products are obtainable. The lowest grade of flour called "dark feeding flour" which contains the germ of the wheat and is rich in oil and protein is a high class feeding stuff for growing pigs, hard-working horses, and milch cows. Shorts which consist of ground-over bran, sweepings of the mill, etc., do not make satisfactory feeding stuffs. Middlings are useful for feeding pigs and horses, as they do not contain much crude fiber. For horses best results are obtained by mixing with oats, and for pigs by mixing with corn or skimmed milk. Of all the by-products of wheat none perhaps reaches all-around feeding conditions as does bran. It is valued as a food for all animals when used in the right proportion with other feeds. Bran is used as a horse food in many well managed stables. It is not suited to hard-working horses owing to its coarse, fibrous nature which requires too much energy to digest. Growing horses, brood mares and stallions can be fed bran liberally because of the large amount of mineral matter that it contains. In the feeding of steers it serves well if fed with corn in any manner. Fed with grain it gives bulk, supplies protein and makes the food more palatable. For dairy cows it is unexcelled as a food, furnishing both protein and ash, so desirable in the formation of milk. For brood sows it may be used with profit, and is also relished by breeding ewes.

As a fertilizer there is no part of wheat as valuable as bran, which together with shorts carry all the elements of fertility in large quantities, and where the interest of the feeder reaches beyond their cattle to the farm they till, makes bran quite important as a fertilizer.

Thus we find in wheat and its by-products one of our most important groups of feeding stuffs. Of high value as a food for man as well as for all other classes of animals, there is no doubt that it will continue to be as it has been in the past the most important of our cereals.

Breeding Horses as Specialists.

Last winter during the State Farmers' Institute held here in Columbus one of the speakers made this statement: "There is no such thing as the general-purpose horse."

While most of the county fairs have a place in their show rings for these horses, and there is generally some sort of a market open for them, still we believe that the speaker was about right. Of course, they have their place, just the same as the unskilled workman who has never received over fifteen or eighteen cents per hour and never expects to, and as this is the age of the specialist there is about the same demand for the one as the other.

The fancy prices that we hear so much about are paid not for the general-purpose horse but for the carefully-bred drafter, coacher or whatever he may be, so that he has been bred for a certain purpose. In other words not for the jack-of-all-trades but for the specialist. Suppose you are breeding high-grade coachers where the action is the main thing, but you try to make Lou Dillons out of them and at the same time retain the action. It can't be done because "high knee-action is not consistent with great speed." Or put them to hauling coal. The weight of the load would soon result in the loss of high action. The so-called general-purpose horse would have drawn a fair-sized load but he could not be classed with the drafters as he hadn't the size and conformation. He might have had a fair degree of action and speed but would belong to neither of these classes as he had not had the breeding and training.

Formerly there were only two distinct breeds—the race horse and the drafter. By judicious selection and crossing the various midway breeds have been formed. It has cost the originators of these breeds a great deal of hard work and time, to say nothing of money, to bring them to where they now are, and as each breed is a specialist along its particular line, why not pay a little more attention to the breeds and not fool so much with crossing, as draft on coach and so on? It does seem to me that horses are the most promiscuously bred of any of our domestic animals. To illustrate: Three years ago last spring a number of farmers organized, bought a good Percheron stallion; before the end of the season the company broke up and the horse was sold. The next season these farmers bred the same mares to a crooked-legged pacer, small and ugly, with a record of 2:30. The following season brought in a coach horse, big, good action and carriage, but with very bad feet. The mares were bred to this horse. Last spring a number of these same farmers formed a new company, bought an imported Belgian stallion and will, I suppose, breed draft horses for at least one year more.

Now one reason for such indiscriminate breeding is that the service fee

was in each case very low. Also it was the handiest horse to get at. But I think the great trouble with those breeders, and there are a great many like them, was that they wanted their mares to raise colts, and, as they had never thought very much about it, supposed that it didn't make any difference what they bred to just so long as it was a horse and had four legs.

In speaking of cross breeding, we notice that Sir Walter Gilby has recommended the crossing of the thoroughbred stallion on the spirited, short-legged cart mare for hunters. Today there is no breed of horse that is an ideal hunter and this cross is supposed to result in the ideal hunter by giving size and staying qualities to the offspring, such qualities having been neglected in the breeding of thoroughbreds for short distance runs on the turf. It is not meant that the thoroughbred has deteriorated, for it is more highly specialized than formerly, as is shown by records. But for a cross-country run after hounds it is found to be rather small for the weight of the rider and lacking in endurance when it comes to rough roads and long runs. If the above-mentioned cross will give the proper type of hunter, short, broad loin, well sprung rib, high, arched neck, straight flat legs, sloping shoulders, then it is the proper thing to do, but it doesn't look wise, to extend it further than the first cross.

But it is necessary to look a little deeper than just to the type. This country has never before been so completely filled up with sires as it has been during the past season and along with the good came the bad. Hence the importance of making a very careful examination of the sire for unsoundness before breeding as it is easy enough to get blemishes without breeding from unsound horses.

In breeding your mares, then, stay close with the type and remember that the every-day general-purpose horse brings an every-day, general-purpose price; the heavy draft horse a heavy draft price, while the high-class gaited horse has a special price of his own as is evidenced by the ten thousand dollars paid for a matched pair, and this in one of our own American cities during the current year. C. D. HYATT.

Growth of Ohio College of Agriculture and Domestic Science.

By Dean H. C. Price, O. S. U.

Previous to 1892, there had been comparatively few students in the Ohio College of Agriculture. It had taken twenty years for the work to become established. Since that time, there has been a steady growth of the college, as well as of the University. In the following tabulation the enrollment of the College of Agriculture and Domestic Science of the Ohio State University is shown since 1892, also the number of students enrolled in the four-year courses and in the two-year course.

The special dairy course was first offered in 1894 and 1895, and the work in domestic science in 1896 and 1897.

In this summary of students it is very noticeable that the greatest increase has been in the four-year courses. The enrollment in the two-year courses has not increased in proportion to the increase of the total enrollment of the college or of the University. It has been found that very many of the students who enroll in the two-year courses do so to prepare themselves for entering the four-year courses so that the number who complete the two-year courses is comparatively few as compared with the number who graduate from the four-year courses. Although this enrollment does not show any phenomenal increase, it shows a healthy growth.

Enrollment in College of Agriculture and Domestic Science and in Ohio State University during thirteen years:

Year.	Agriculture and Horticulture, Four Year Courses.	Agriculture, Two Year Courses.	Dairy Course.	Domestic Science Courses.	Total College Agriculture and Domestic Science.	Ohio State University, Entire Enrollment.
1891-92..	5	35	....	..	40	668
1892-93..	16	31	....	..	47	794
1893-94..	19	52	....	..	71	800
1894-95..	38	41	11	..	90	810
1895-96..	41	34	8	..	83	969
1896-97..	33	44	13	7	97	1019
1897-98..	58	41	29	16	144	1099
1898-99..	53	53	19	39	164	1149
1899-00..	53	42	23	39	157	1252
1900-01..	64	49	50	47	210	1449
1901-02..	63	51	40	44	198	1515
1902-03..	88	71	40	44	243	1735
1903-04..	108	70	32	36	256	1803

Special students, 8; post-graduate students, 2.

In previous years these have been included in the regular courses.

O. S. U. at the International.

From year to year, the International Fat Stock Show excites more interest at O. S. U. A crowd of about thirty students, under the leadership of Professor Plumb, spent several days of the past week there, and all report a very enjoyable time. The University was represented in the students' judging contest by the following men: J. V. Hyatt, W. A. Martin, F. L. Allen, B. Griffin, and F. L. West. The report of the judges has not yet been made, but it is hoped the team made a good showing both for themselves and the University. In the meeting of the American Confederation of Students of Agriculture, O. S. U., was represented by J. C. White, who gave a very interesting and instructive talk.

On Tuesday afternoon, the party was entertained by the Schwarzschild & Sulzberger Packing Company. After a tallyho ride through the yards they were very courteously shown through the establishment of the company. Everyone fully enjoyed it, and did not fail to make manifest their hearty appreciation of the courtesy bestowed upon them. Having spent four very profitable days at the show, the return home was made on Wednesday. There is much to be gained from a trip of this kind, and the members of the party wish to thank Professor Plumb for his efforts in making the trip a success.

Children and Pets.

All kinds of pets love children to such an extent that even cruel torture may be inflicted by those children and the animal still refuse to use its natural means of defense, or do more than strive to run away to escape the torment. Many children, in spite of the Bands of Mercy and Humane Societies are thoughtless, if not cruel; many are easily led, and join in the fun (?) of tying tin cans to the tails of animals when they see the other children engaged in this cruel sport. Therefore parents should see that the precepts of kindness to animals, taught universally in school and church, should be carried out in daily life.

Children should thoroughly understand from the first that pets placed in their care must receive food and drink at certain hours each day; that the food must be properly prepared, and that the water for drinking of the right temperature.—October Woman's Home Companion.

General Agriculture News.

Mr. N. C. Hamner, a graduate of the University of Virginia in the class of 1902, and Mr. A. W. Clark, a graduate of the University of Vermont in the class of 1904, have been appointed as-

sistant chemists in the Agricultural Experiment Station of the Pennsylvania State College. The United States Secretary of Agriculture has appointed Mr. F. W. Christensen assistant expert in animal nutrition and assigned him to duty in connection with the respiration calorimeter. Mr. R. E. Stallings has been transferred to the position of assistant in animal nutrition and will devote the remainder of the year to investigation with the respiration calorimeter.

In addition to agricultural hall, a judging pavilion and a new greenhouse, have been erected at the Iowa Agricultural College. The new dairy building will be completed, by the opening of next term, at a cost of $55,000. This is a three-story building, 60x100 feet, with basement and attic. It is of fireproof construction with pressed brick and cut-stone walls and enameled brick, tile and pressed brick interior finish. A new central agricultural building will be begun during the coming year, which will cost when completed about $375,000.

Dr. N. S. Mayo, for a decade veterinarian at the Kansas Agricultural College, has resigned his position there to take up work under the Cuban government.

Dr. W. A. Kellerman, head Professor of Botany, will spend February and March in Gautemala studying and collecting the parasitic species of fungi of the native and cultivated plants of that country.

At a recent meeting of the board of trustees, James S. Hine, Associate Professor of Zoology and Entomology, was granted leave of absence for the winter term of the present college year. He will spend the time in Gautemala collecting zoological specimens for the museum of this institution.

Mr. Ernest Shearer, M. A., B. Sc., Kirkwall, has been appointed lecturer on agriculture at the Pusa Imperial College, Bengal. This agricultural college for all India, with a farm of 1,300 acres attached, is one of the developments resulting from the appointment two or three years ago of another Scotsman, Mr. James Mollison, as inspector-general of agriculture in India. Mr. Alexander Sangster, Montrose, has been appointed junior assistant with the Abukin Land Reclamation Company, near Alexander, Egypt, and Mr. John C. Leslin, B. Sc., has been appointed assistant conservator of forests in Southern Nigeria.

University News.

The University Glee and Mandolin Clubs will give their opening concert Friday evening December 9. F. R. Guilford is the manager this year and promises to give the student body a better concert than ever before offered. The combined clubs number 40 members. Russell Hare of Marysville is director of the Glee Club, and Clarence Laylin of Columbus of the Mandolin Club. The clubs are giving daily rehearsals preparatory to the concert. The Ladies' Glee Club will also have a couple of numbers on the program.

The O. S. U. Debating Club will meet the Western Reserve University Club at the O. S. U. Chapel the last Friday night of February. The question to be debated, "Shall the United States increase her navy?" O. S. U. will have the negative. The first preliminary will take place December 12 at the chapel. O. S. U. will take the affirmative of the same question with the University of West Virginia later in the year.

Ohio State sent representatives from the Agricultural College to the International Live Stock Exposition at Chicago. The men sent to represent this college in the student judging contest were F. L. Allen, J. V. Hyatt, B. Griffin, W. A. Martin and F. L. West.

The Strollers of the State University will give their initial performance January 6 at the chapel. Oliver Goldsmith's She Stoops to Conquer" is the play selected by this dramatic club. Already the cast of characters have been chosen and work begun on the comedy. L. R. Haller has been elected business manager of the club.

The tenth semi-annual Battalion Hop was held at the O. S. U. Armory Friday evening, November 18. Quite a crowd of students appeared in uniform and an enjoyable evening was spent.

Twenty fraternity men met at Professor Cole's house on Sunday, November 13, and took up the study of the Bible. Five fraternities will inaugurate Bible classes in their fraternity houses Although this work is practiced in other colleges, it is the first time in the history of O. S. U. It shows what an effect the University Y. M. C. A. is having on the student body.

The O. S. U. football schedule for this season is ended. We have good reasons to feel proud of our team, even if we met with sore defeats in a few games. From beginning to finish there has been a greater interest shown in football this year among the students than ever before. An illustration of the interest was manifested in the department and class teams. It is from these smaller teams that the material is found for making a strong 'Varsity team.

The Agricultural football team made a remarkable showing this year. In their three games they showed a total of 15 points against 11 of their opponents. The good work of the team was due to the manager and captain—W. H. Pew and C. D. Hyatt.

The experimental macadam drive being constructed from Townshend Hall to Neil avenue under the supervision of the government is nearing completion. The road is constructed of a bed of brick, gravel and crushed granite boulders. It promises to be one of the most excellent drives in the state.

Work on the new buildings is being rapidly pushed. Physics building is nearly completed; the foundations of Ceramics building are in and men are busily engaged in excavating for the foundations of Chemical building. The new Chemistry building is to be built somewhat upon the plan of Townshend Hall, but will be of red brick.

Dairy Notes.

Prof. J. W. Decker will attend the Pennsylvania Dairy Union meeting at Harrisburg, Pa., next week.

Work in the dairy laboratory is progressing slowly but steadily, and the boiler will be set today, November 26. and a class will begin a week's test of the University dairy herd next Monday. The laboratory will be one of the best equipped dairy laboratories in the country when completed.

The Ohio State Dairyman's Convention will be held at the University probably some time in February.

Mr. E. D. Holl, who has been running a creamery at New Washington since last winter, will return and resume his University work the beginning of next term.

Local.

McLaughlin Brothers, of Columbus, the largest importers of draft horses in America, shipped a special trainload of horses to Chicago for the International Stock Show, to be held November 26th to December 3d. Nearly all of these horses are prize winners both in France and the United States, many of them winning over all competitors at the great World's Fair at St. Louis. This trainload of horses represented more value than was ever shipped from any breeding or importing establishment at any one time in the world.

The Christmas Delineator.

The December Delineator, with its message of good cheer and helpfulness, will be welcomed in every home. The fashion pages are unusually attractive, illustrating and describing the very latest modes in a way to make their construction during the busy festive season a pleasure instead of a task, and the literary and pictorial features are of rare excellence. A selection of Love Songs from the Wagner operas, rendered into English by Richard de Gallienne and beautifully illustrated in colors by J. C. Leyendecker, occupies a prominent place, and a chapter in the Composers' Series, relating the Romance of Wagner and Cosima, is an interesting supplement to the lyrics. A very clever paper entitled "The Court Circles of the Republic," describes some unique phases of Washington social life is from an unnamed contributor, who is said to write from the inner circles of society. There are short stories from the pens of F. Hopkinson Smith, Robert Grant, Alice Brown, Mary Stewart Cutting and Elmore Elliott Peake, and such interesting writers as Julia Magruder, L. Frank Baum, and Grace MacGowan Cooke hold the attention of the children. Many Christmas suggestions are given in needlework and the Cookery pages are redolent of the Christmas feast. In addition, there are the regular departments of the magazine, with many special articles on topics relating to woman's interests within and without the home.

New Book—Just Issued.

Poultry Feeding and Fattening—A handbook for poultry keepers on the standard and improved methods of feeding and marketing all kinds of poultry.

The subject of feeding and fattening poultry is prepared largely from the side of the best practice and experience here and abroad, although the underlying science of feeding is explained as fully as needful. The subject covers all branches, including chickens, broilers, capons, turkeys and waterfowl; how to feed under various conditions and for different purposes. The whole subject of capons and caponizing it treated in detail. A great mass of practical information and experience not readily obtainable elsewhere is given, with full and explicit directions for fattening and preparing for market. The broad scope of the book is shown in the following table of contents: Profits in Poultry, Care of Poultry, Where to Keep Fowls, Breeds and Breeding, Feeds and Feeding, Hatching and Rearing the Natural Way, Artificial Incubation, Broilers and Capons, The Market End, Waterfowl, Turkeys, Guineas, Pea Fowls, Pigeons and Squab Raising, Enemies and Diseases.

Profusely illustrated, 160 pages; 5x 7½ inches. Cloth. Price, 50 cents, postpaid. Orange Judd Company, 52 Lafayette Place, New York, N. Y. Marquette Building, Chicago, Ill.

CHR. HANSEN'S LABORATORY
LITTLE FALLS, N. Y.

At the World's Fair in St. Louis, Chr. Hansen's Laboratory was awarded the grand prize for their world renowned preparations, consisting of Rennet Extract, Cheese Color, Butter Color, Rennet Tablets, Cheese Color Tablets, etc., for butter and cheesemaking. These goods have been awarded over 130 first-class gold and silver medals wherever exhibited, and are used all over the world. They are the standards by which all others are measured.

The Junket Tablets for dainty, delicious, healthful, nutritious puddings,—and for making a better and cheaper ice cream than by any other means known—received also the grand prize at St. Louis.

This is a well-deserved compliment to Chr. Hansen's Laboratory, and we extend congratulations.

A NEW AND NEEDED WORK.

The Most Comprehensive, Concise, Up-to-date and Authoritative Farm Book.

Farmer's Cyclopedia of Agriculture—A compendium of agricultural science and practice on farm, orchard and garden crops, the feeding and diseases of farm animals, dairy farming and poultry in the United States and Canada, by Earley Vernon Wilcox, Ph. D., and Clarence Beaman Smith, M. S., assistant editors in the office of experiment stations, United States Department of Agriculture. Over 700 royal octavo pages (9½x7 inches), 500 original illustrations, an index of 6000 to 7000 topics. Cloth, $3.50; half morocco, $4.50. New York, Chicago and Springfield, Mass., Orange Judd Co.

Book Notice.

GOFF AND MAYNE'S FIRST PRINCIPLES OF AGRICULTURE. By Emmet S. Goff, late Professor of Horticulture, University of Wisconsin, and D. D. Mayne, Principal, School of Agriculture, St. Anthony Park, Minn. Cloth, 12mo., 256 pages. With illustrations. Price, 80 cents. American Book Company, New York, Cincinnati and Chicago.

While not too difficult for boys and girls in the lower classes, this volume covers well the elements of agriculture in its various branches. Commencing with a simple discussion of the soil and its relations to plant life, it takes up, lesson by lesson, the principles that a farmer should understand how to raise good crops and good livestock. The last lessons deal with the simpler phases of landscape gardening, under the title, "Improvement of Home and School Yards." Throughout, the lessons include simple laboratory exercises. The appendix contains tables showing the constituents of fodders and foods, formulas for areas, volumes, and the like, and diagrams of animals with the names of their parts. The book is thoroughly illustrated with cuts and diagrams, and with eight full-page colored plates of cattle, poultry, and fruits. This volume should be widely used in rural schools.

"RUNS LIKE A TOP"

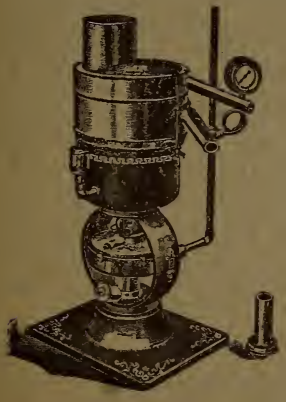
The Twentieth Century Babcock Tester.

Gearing all at the top of machine and enclosed in case. Runs with the utmost ease. A speed of 1000 revolutions per minute can easily be reached. Just as accurate results can be obtained as from use of large Turbine machine.

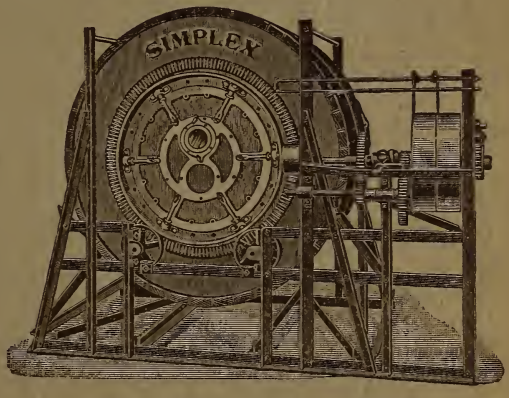
Creamery Package Mfg. Co.

CHICAGO, ILL.

TWO OF OUR SPECIALTIES



"SIMPLEX" Link-Blade Cream Separator.



"SIMPLEX" Combined Churn and Butter Worker.

We manufacture other specialties for use in creameries, cheese factories and dairies; "SIMPLEX" Regenerative Pasteurizer, "B. & W." Heaters; Check Pumps and Steel Vats; "FACILE" Babcock Milk Testers; Sprague Continuous Pressure Adjustable Cheese Presses, &c.

Send for our general illustrated catalogue.

D. H. BURRELL & CO., Little Falls, N. Y.

Tubulars Stand Great Test

We insist upon **truth** in Tubular advertisements. We **prove** Tubulars will do what we claim **before** we claim it. Tubulars are **more durable** than all other separatore. We **guarantee** this. **Back** of this guarantee is **absolute knowledge** of Tubular quality. **Actual tests** of Tubulars surprise the doubters every time. **Here is a hard test:** On Aug. 2, 1904, we attached a No. 9 Dairy Tubular to a mechanical driving apparatus that turns the machine as a man would. This Tubular was not specially selected, but was taken at random from the many finished Tubulars in our ware house. This Tubular, at date of writing, has been in **constant** operation, every working day, for three and one half months. It has run **fifty hours a week** for fifteen weeks—and is still running. Below we give facts and figures of the test, up to Nov. 15, showing what **wonderful** work this Tubular has done, and how easy it has done it.

Dairy Tubular Separator

A Hard Test

Dairy Tubular Bowl

Machine under test,	**No. 9 Tubular**
Capacity,	**900 lbs. per hour**
Hours in operation,	**750**
Totai time adjusting,	**Not any**
Total time oiling,	**Not over three minutes**
Total repairs,	**Not any**
Total oil used,	**Not over 2 quarts**
Revolutions of crank,	**1,972,575**
Revolutions of bowl,	**720,000,000**
Number pounds separated,	**675,000**

675,000 lbs. of milk is about equal to the yield of ten average cows for a period of 11 years, 6 months, and 23 days. The test is **unequalled.** It confirms **all** we claim for the Tubular—is positive guarantee of quality. It shows that Tubulars are capable of doing work equal to at least eleven years service in a ten cow dairy, with no expense for repairs and with the use of not over two quarts of oil. The test still coutinues. This Tubular will greatly surpass its performance up to the prssent. At time of writing (Nov. 15) it shows almost no wear. We will keep you informed about the doings of this machine.

Write for Cataloge

The Sharples Co.,
Chicago, Ill.

P. M. Sharples,
West Chester, Pa.